REMARKS

Claims 1-17 are currently pending in the subject application, and are presently under consideration. Claims 1-17 are rejected. Favorable reconsideration of the application is requested in view of the comments herein.

I. Rejection of Claims 1-5 and 12-13 Under 35 U.S.C. §103(a)

Claims 1-5 and 12-13 stand rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,363,087 to Rice ("Rice") in view of U.S. Patent No. 5,323,404 to Grubb ("Grubb"). Withdrawal of this rejection is respectfully requested for at least the following reasons.

Claim 1 recites a multimode fiber having a core incorporating radially dependent amounts of doping materials to provide a desired refractive index profile and a desired Raman gain coefficient profile that favors lower order modes and discriminates against higher order modes, wherein light launched into an end of the fiber is subject to higher Raman gain along the optical axis, which promotes lower order modes and discriminates against higher order modes. In the Response to the Office Action dated October 27, 2005, Representative for Applicant argued that Rice does not teach or suggest doping materials to provide a desired Raman gain coefficient profile that favors lower order modes and discriminates against higher order modes, as recited in claim 1. In response, in the Office Action dated April 10, 2006 ("Office Action"), the Examiner states that "Applicants arguments...have been fully considered and are persuasive," (Office Action, page 2) and asserts that Rice teaches "a core having a longitudinal optical axis including providing a desired refractive index profile and a desired Raman gain coefficient profile that favors lower order modes," (Office Action, page 3; citing Rice, col. 2, ll. 48-58 and col. 6, ll. 30-38).

The Examiner appears to concede that Rice does not teach or suggest doping materials to provide a desired Raman gain coefficient profile that favors lower order modes and discriminates against higher order modes, as recited in claim 1. The Office Action relies on Grubb to teach "a single mode optical fiber which uses radially dependent amounts of dopant material to affect the

gain and the refractive index," (Office Action, page 3; citing Grubb, FIG. 6; and col. 5, ll. 1-11). The Office Action further states that the "fiber [of Grubb] is single mode, but the teaching is that of a doping profile which increases Raman processes," (Office Action, page 3). Representative for Applicant respectfully disagrees with the Office Action's assertion that Grubb teaches a single mode optical fiber which uses radially dependent amounts of dopant material to affect the gain and the refractive index.

Grubb teaches a Raman amplifier for a given wavelength of pump signal radiation and a Raman laser having an output suitable for pumping an Er-doped fiber amplifier (Grubb, Abstract). The section of Grubb cited by the Examiner discloses that:

> Germania is almost universally used as index-raising dopant in silica-based optical fibers. The presence of GeO_2 is known to result in an increase in the peak height of the Stokes band. The presence of other possible fiber constituents may further modify the spectrum. For instance, the presence of P_2O_5 in silica results in a further peak at about 1320 cm^{-1}. The refractive index profile of an exemplary single mode optical fiber that can be used to practice the invention is shown in FIG. 6. The Ge-doped core has 6.1 μm diameter, the deposited cladding region surrounding the core is F-doped, and outer cladding region is undoped silica. (Grubb, col. 5, ll. 1-11).

As described in this section of Grubb, doping is used to affect a refractive index profile of a single mode optical fiber. However, there is no indication in this section of Grubb, or in any other section of Grubb, that the amount of dopant of the single mode core of Grubb is radially dependent. The cited section merely states that the fiber core is doped, but provides no teaching or suggestion as to radially based variations in the amount of dopant in the fiber core.

In addition, as cited above, the optical fiber described by FIG. 6 of Grubb is merely an example of a fiber that can be used in the Raman amplifier of Grubb (Grubb, col. 5, 8-10). Grubb teaches the use of resonant cavities formed from in-line refractive gratings (Grubb, Abstract). The use of such resonant cavities makes continuous wave (CW) pumping feasible for certain wavelengths, thus providing a more efficient shifting of pump power based on stimulated Raman scattering (SRS) (Grubb, col. 3, ll. 19-30). Furthermore, the amplifier of Grubb utilizes

an intrinsic property of the material of the fiber (Grubb, col. 4, ll. 52-54). Thus, the Raman amplification of Grubb is based on a more efficient SRS process that is intrinsic to the fiber. Accordingly, Grubb provides no teaching or suggestion that the doping of the single mode fiber described in the above cited section and FIG. 6 of Grubb provides an effect on Raman gain. Therefore, the Examiner's assertion that Grubb teaches a doping profile which increases Raman processes is incorrect, as Grubb teaches neither a doping profile (*i.e.*, radially dependant amount) nor an increase in Raman gain resulting from fiber doping. Accordingly, Grubb does not teach or suggest a core incorporating radially dependent amounts of dopant materials to provide a desired refractive index profile and a desired Raman gain coefficient profile, as recited in claim 1.

As stated above, the Examiner asserts that "the teaching [of Grubb] is that of a doping profile which increases Raman processes," and "[i]t would be obvious...to combine the optical fiber of Rice with the doping profile of Grubb..." (Office Action, page 3). Based on the Examiner's language used in the rejection of claim 1, it appears that the Examiner's reliance on Grubb seems to be mostly concerned with a doping profile as taught by Grubb. Assuming *arguendo* that FIG. 6 of Grubb does, indeed, indicate a doping profile based on potential differences in doping between the core (reference number 60) and the cladding (reference number 61), a rejection based solely on a doping profile of Grubb in combination with a fiber core of Rice is not proper. Specifically, for the Examiner to rely on Grubb only to show a doping profile demonstrates a failure to consider the invention of claim 1 as a whole, as mandated by 35 U.S.C. §103(a). As described above, Grubb merely teaches that a fiber core is doped, and that the surrounding cladding is doped (Grubb, col. 5, ll. 1-11). However, the language of claim 1 regarding radially dependent amounts of dopant is directed specifically to a fiber core alone. Thus, a rejection of claim 1 based on a fiber core taught by Rice combined with a doping profile resulting from a change in dopant from the single mode Ge-doped core to the F-doped cladding, as taught by Grubb, is improper as it does not consider the invention of claim 1 as a whole.

Representative for Applicant further respectfully submits that there is no motivation for one of ordinary skill in the art to combine the teachings of Rice and Grubb to achieve the invention of claim 1, contrary to Examiner's assertion in the Office Action (see Office Action, page 3). The teachings of Rice are directed toward a fiber amplifier having a dual clad design that provides an SRS amplified output (see, *e.g.*, Rice, Abstract). As described above, Representative for Applicant has demonstrated that Rice does not teach or suggest doping materials to provide a desired Raman gain coefficient profile that favors lower order modes and discriminates against higher order modes, as recited in claim 1. Thus, the invention of Rice achieves Raman gain without the use of dopant materials. In addition, Grubb teaches a doped single mode fiber core that achieves a given refractive index (Grubb, col. 5, ll. 7-10). The fiber core taught by Grubb is thus not doped to provide a desired Raman gain coefficient profile. Furthermore, as the fiber core of Grubb is single mode, it cannot be doped to favor lower order modes and discriminate against higher order modes. Therefore, one of ordinary skill in the art would not combine an undoped fiber, as taught by Rice, with a single mode fiber doped to provide a given refraction index, as taught by Grubb, to achieve a multimode fiber having a core incorporating radially dependent amounts of doping materials to provide a desired refractive index profile and a desired Raman gain coefficient profile that favors lower order modes and discriminates against higher order modes, as recited in claim 1. Accordingly, there is no motivation for one of ordinary skill in the art to combine the teachings of Rice and Grubb to achieve the combination recited in claim 1.

For all of the above reasons, neither Rice nor Grubb, individually or in combination, teaches or suggests claim 1. Withdrawal of the rejection of claim 1, as well as claims 2-5, 12, and 13 which depend therefrom, is respectfully requested.

Representative for Applicant respectfully submits that the Office Action, in rejecting claims 2-4, does not address the language of claims 2-4, but simply rejects them along with claim 1 (Office Action, page 3). Claim 2 depends from claim 1, and thus should be allowed for at least the reasons described above regarding claim 1. In addition, claim 2 recites that the core incorporates radially dependent amounts of selected transparent oxides to provide radially

dependent control of the refractive index; and radially dependent amounts of a dopant that affects the Raman gain coefficient to provide a radially dependent Raman gain coefficient profile, and that the Raman gain coefficient have their highest values along the optical axis of the fiber. Rice discloses a Raman pump core, which receives a focused pump beam that that becomes evenly distributed in the Raman pump core to provide Raman gain for a signal wave in the single mode core (Rice, col. 3, ll. 40-50). The Raman gain is provided by the equation $(g_R*P_p)/A_p$, where g_R is the Raman gain coefficient, P_p is the pump beam power, and A_p is the cross-sectional area of the pump core (Rice, col. 3, ll. 46-48). Rice thus teaches that the gain is uniformly distributed, and therefore constant, across the entire cross-sectional area of the Raman pump core. Accordingly, Rice does not teach or suggest radially dependent control of the Raman gain coefficient, as recited in claim 2. In addition, because the Raman gain occurs through the SRS process in the Raman pump core, the teachings of Rice suggest that Raman gain is greater in the Raman pump core than in the single mode core at the optical axis. Therefore, Rice does not teach or suggest that the Raman gain coefficient has its highest values along the optical axis of the fiber, as recited in claim 2.

The addition of Grubb does not cure the deficiencies of Rice to teach or suggest claim 2. As described above, Grubb teaches a doped single mode fiber, and that Raman amplification is intrinsic to the fiber (Grubb, col. 5, ll. 7-10 and col. 4, ll. 52-54, respectively). As also described above, Grubb is silent as to radially dependent amounts of dopants to affect Raman gain. Therefore, Grubb does not teach or suggest radially dependent control of the Raman gain coefficient, as recited in claim 2. In addition, claim 2 is directed to a multimode fiber. As the fiber of Grubb is only a single mode fiber, the fiber of Grubb can only experience Raman gain along the single mode axis of the fiber. Thus, Grubb does not teach or suggest that the Raman gain coefficient has its highest values along the optical axis of the fiber, as recited in claim 2, because Grubb teaches that there cannot be any values for a Raman gain coefficient other than at the axis of the single mode fiber core. Accordingly, neither Rice nor Grubb, individually or in combination, teach or suggest claim 2. Withdrawal of the rejection of claim 2, as well as claims 3-5 which depend therefrom, is respectfully requested.

Claim 4 depends from claim 1, and thus should be allowed for at least the reasons described above regarding claim 1. In addition, claim 4 recites that the Raman gain coefficient profile has a generally parabolic shape with a peak coinciding with the optical axis of the fiber. As described above with regard to claim 2, Rice does not teach or suggest that the Raman gain coefficient has its highest values along the optical axis of the fiber. As also described above, regarding claim 2, Grubb teaches a single mode fiber, and thus can only have a Raman gain coefficient along the single mode fiber axis. Thus, Grubb cannot teach or suggest a Raman gain coefficient profile with a generally parabolic shape because it can only have a single Raman gain coefficient value. Accordingly, neither Rice nor Grubb, individually or in combination, teach or suggest that the Raman gain coefficient profile has a generally parabolic shape with a peak coinciding with the optical axis of the fiber, as recited in claim 4. Withdrawal of the rejection of claim 4 is respectfully requested.

Claim 5 depends from claim 1, and thus should be allowed for at least the reasons described above regarding claim 1. In addition, claim 5 recites that dopant concentrations are selected to provide a measure of independent control over the Raman gain coefficient profile. As described above regarding claim 1, neither Rice nor Grubb teach or suggest doping a core to provide a Raman gain coefficient profile. Accordingly, neither Rice nor Grubb teach or suggest that dopant concentrations are selected to provide a measure of independent control over the Raman gain coefficient profile, as recited in claim 5. Withdrawal of the rejection of claim 5 is respectfully requested.

Claim 12 depends from claim 1, and thus should be allowed for at least the reasons described above regarding claim 1. In addition, claim 12 recites that the radially dependent amounts of dopant materials comprise a minimum amount of dopant material near an interface between the core and the cladding region with a gradual transition to a maximum amount at the optical axis. The Office Action asserts that claim 12 is taught by Grubb (Office Action, page 4; citing Grubb, FIG. 2 and col. 5, ll. 1-4). Representative for Applicant respectfully disagrees, and further assumes that Examiner intended to cite FIG. 6, and not FIG. 2. As described above, Grubb teaches that doping is used to affect a refractive index profile of a single mode optical

fiber (Grubb, FIG. 6 and col. 5, ll. 1-11). However, there is no indication in this section of Grubb, or in any other section of Grubb, that the amount of dopant of the single mode core of Grubb is radially dependent. Thus, Grubb fails to teach or suggest that the radially dependent amounts of dopant materials comprise a minimum amount of dopant material near an interface between the core and the cladding region with a gradual transition to a maximum amount at the optical axis, as recited in claim 12. Accordingly, neither Rice nor Grubb, individually or in combination, teach or suggest claim 12. Withdrawal of the rejection of claim 12 is respectfully requested.

For the reasons described above, claims 1-5 and 12-13 should be patentable over the cited art. Accordingly, withdrawal of this rejection is respectfully requested.

II. Rejection of Claims 6-9, 11, and 14-17 Under 35 U.S.C. §103(a)

Claims 6-9, 11, and 14-17 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Rice and further in view of Grubb and WO 02/50964 A2 to Clarkson ("Clarkson"). Withdrawal of this rejection is respectfully requested for at least the following reasons.

Claim 6 recites, in pertinent part, a multimode fiber comprising a core having radially dependent amounts of dopant materials to provide a desired Raman gain coefficient profile that favors lower order modes and discriminates against higher order modes. For substantially the same reasons as given for claim 1, neither Rice nor Grubb teach or suggest claim 6. The addition of Clarkson does not cure the deficiencies of Rice and Grubb to teach or suggest claim 6. Clarkson teaches a fiber-based optical source with a high power laser diode stack pump source shaped into an intense beam of elongated cross section by use of focusing and light concentrating elements (Clarkson, Abstract). However, the combination of Rice, Grubb, and Clarkson does not teach or suggest a multimode fiber comprising a core having radially dependent amounts of dopant materials to provide a desired Raman gain coefficient profile that favors lower order modes and discriminates against higher order modes, as recited in claim 6. Withdrawal of the rejection of claim 6, as well as claims 7-10, 14, and 15 which depend therefrom, is respectfully requested.

Claim 7 depends from claim 6, and thus should be allowed for at least the reasons described above regarding claim 1. Claim 7 recites that the Raman gain coefficient profile has a generally parabolic shape with a peak coinciding with the optical axis of the fiber. For the reasons described above regarding claim 4, claim 7 should be allowed over the prior art. The addition of Clarkson does not cure the deficiencies of Rice and Grubb to teach or suggest claim 7. Withdrawal of the rejection of claim 7 is respectfully requested.

Claim 11 recites, in pertinent part, a method of generating a diffraction limited high brightness laser beam in a multimode fiber comprising providing a core with radially dependent amounts of at least one dopant that provides a Raman gain index profile with maxima coinciding with an optical axis of the fiber, and in the fiber, favoring the lowest order mode by providing maximum Raman gain along the optical axis, and discriminating against higher order modes. For substantially the same reasons as given above for claims 1, 4, and 6, claim 11 should be allowed over the cited art. Withdrawal of the rejection of claim 11, as well as claims 16 and 17 which depend therefrom, is respectfully requested.

Claims 14 and 17 each recite incorporating a minimum amount of dopant material near an interface between the core and the cladding region with a gradual transition to a maximum amount at the optical interface. For substantially the same reasons as given for claim 12, neither Rice nor Grubb teach or suggest claims 14 and 17. The addition of Clarkson does not cure the deficiencies of Rice and Grubb to teach or suggest claims 14 and 17.

For the reasons described above, claims 6-9, 11, and 14-17 should be patentable over the cited art. Accordingly, withdrawal of this rejection is respectfully requested.

III. Rejection of Claim 10 Under 35 U.S.C. §103(a)

Claim 10 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Rice, Grubb and Clarkson, and further in view of U.S. Publication No. 2003/0161361 to Paldus, et al. ("Paldus"). Withdrawal of this rejection is respectfully requested for at least the following reasons.

Claim 10 depends from claim 6, and should be allowable for at least the reasons described above regarding claim 6. The addition of Paldus does not cure the deficiencies of Rice, Grubb, and Clarkson to teach claim 6. Paldus teaches a laser tuning mechanism that embodies spectrally dependent spatial filtering (Paldus, Abstract). However, the combination of Rice, Grubb, Clarkson, and Paldus, individually or in combination, does not teach or suggest a multimode fiber comprising a core having radially dependent amounts of dopant materials to provide a desired Raman gain coefficient profile that favors lower order modes and discriminates against higher order modes, as recited in claim 6, from which claim 10 depends. Accordingly, claim 10 should be patentable over the cited art. Withdrawal of the rejection of claim 10 is respectfully requested.

CONCLUSION

In view of the foregoing remarks, Applicant respectfully submits that the present application is in condition for allowance. Applicant respectfully requests reconsideration of this application and that the application be passed to issue.

Please charge any deficiency or credit any overpayment in the fees for this amendment to our Deposit Account No. 20-0090.

Respectfully submitted,

Date 7/05/06

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